Calculation of Normal Shock Waves in Boiling Liquids

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The description of shock waves in ordinary gases and condensed matter is expected to be part of the dynamics of the system. As such, it depends on the boundary conditions, the geometry and also the chemical kinetics describing that system. This talk is about the so-called evaporation waves seen in superheated liquids. These waves are observed experimentally as a steep front of liquid/vapour phase change travelling through the superheated liquid when it is brought to boiling by some kind of mechanical disturbance. Visually, the wave is represented by the moving meniscus of the liquid which is seen to fall by a constant speed when the homogeneous liquid phase is transformed into a two-phase liquid/vapour system. Compared to shock waves propagating through premixed gases and high explosives , which typically travel at the speed of 1000 - 10,000 m/s, the instantaneous "boiling rate" of the superheated liquid is only 0.1 - 1 m/s. Interestingly, the physics describing both of these phenomena is the same, and to our big surprise it can be explained using equilibrium thermodynamics - with just one additional assumption.